



The New
Standard for
Sunlight
Readable
Switches

Vivisun 20/20TM

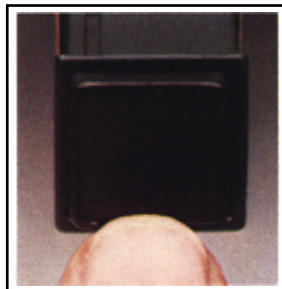
The Fully Qualified Sunlight Readable Mil-Spec Switch

MIL-S-22885/90



Sunlight Readable

Low Power Vivisun 20/20 is readable in a light ambient of 10,000 foot candles (direct sunlight).



No Ghosting- Low Power Vivisun 20/20 maintains total dead face in a light ambient of 10,000 foot candles (direct sunlight) when not energized.

Specify Vivisun 20/20 whenever dependable sunlight readability becomes a crucial factor in safety considerations.

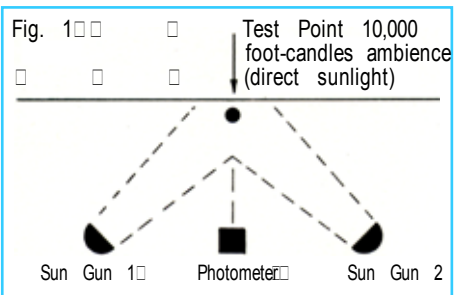
VIVISUN 20/20 IS A TRADEMARK OF AEROSPACE OPTICS INC. PATENT PENDING

Applications: Throughout the world on military and commercial aircraft, Vivisun 20/20 is now in use in cockpits and flight decks in conjunction with the following:
Master Warning Systems,
Navigation Mode Select Systems,
Keyboards
Marker Beacon Indicators
Auto Pilot Systems,
Flight Director Systems
and Counter
Measures
Systems.
Vivisun 20/20
is also in use
on Base
Security
Systems
and
Flight Inspection
Equipment.



The Aerospace Optics Laboratory Measurement of Sunlight Readability

The Sunlight Readability of a display is measured in our photometric laboratory by determining specific contrast ratios when the display is subjected to a 10,000 foot-candle ambience (direct sunlight) (Fig. 1):



(2) The sun guns are then calibrated to produce a 10,000 foot-candle ambience (direct sunlight) on the reflective standard as measured by using a Gamma Scientific 2020E Photometer. (3) The reflective standard is then replaced by the display to be tested.



To determine the contrast ratios, take three brightness measurements as shown in Fig. 2: (B2) a .011" diameter area on the energized legend, (B3) the same area with the legend unenergized, and (B1) a .011 area on the background adjacent to the area measured on the legend.

Compute the contrast ratios with the following formula:

$$\text{On/Background Contrast, } C = \frac{B2-B1}{B1}$$

$$\text{Off/Background Contrast, } C1 = \frac{B1-B3}{B3}$$

The legends are Sunlight Readable when the contrast ratio (C) of the legend on to background is greater than 0.6 and the contrast ratio (C1) of the legend off to background is 0.0 ±.05.

Aerospace Optics Make Vivisun 20/20 Non-Ghosting

The importance of Sunlight Readable lighted switches and indicators has reached a new level of priority. The new Aerospace Optics VIVISUN 20/20 displays have satisfied this priority. An area of tremendous pilot concern in the past has been the creation of Ghost Legends. Webster refers to ghost as "a false image appearing." These messages, which appear when not energized, are what we often refer to as GHOST LEGENDS.

In today's sophisticated electronics, annunciation to alert the pilot to specific aircraft information is of prime importance. The possibility of an image of a non-illuminated message cannot be allowed.



Aerospace Optics, through dedicated research, has created a unique lighting system which eliminates ghosting and creates a total dead face when not illuminated as per MIL-STD-411D. The VIVISUN 20/20 provides an average contrast ratio from the unlighted legend to the background of .03 in an ambient light of 10,000 foot-candles (direct sunlight), therefore eliminating any possibility of the GHOST LEGEND appearing when not energized.

This advanced technology of Aerospace Optics and the VIVISUN 20/20 Series of pushbutton switches and indicators have created a new standard in the area of cockpit lighting. Sunlight readable requirements have been achieved so that the message is not only readable when energized in a sunlight condition (10,000 foot candles ambience), but is not discernible (a totally invisible face) when not illuminated, which eliminates the possibilities of GHOST LEGENDS.

Vivisun 20/20 is Uniform Trimmable. No Hot Spots.

Cockpit lighting displays must meet two basic criteria on today's aircraft. The displays must be readable in direct sunlight, and also under night flying conditions



5 Sunlight Readable Colors: Red, Yellow, Green, White and new 20/20 Blue. Only Vivisun 20/20 delivers a Sunlight Readable Blue as an additional advisory color for safety and better pilot/system interface.

when the power is trimmed. This requires a uniformity of lighting not previously available. In response to repeated requests, Aerospace Optics designed a lighting system from the ground up, using the low power lamp and a unique optics system. The result is the VIVISUN 20/20, the advanced state-of-the-art in illuminated switches and indicators.

All colors dim uniformly on the VIVISUN even at the low voltages used for night flying conditions. A common problem in older lighting systems is "hot spots" that develop when power is trimmed, so that part of the message is too brightly illuminated while other segments are barely discernible. This creates a definite hazard to the air crew since an important message can be missed. The VIVISUN 20/20, through its optics system, provides greater uniformity and complete visibility at all voltage levels.



Color differentiation at low voltage levels has also been a design problem, especially where white and amber are used, since the two colors tend to appear similar at low voltage. The new VIVISUN 20/20 is the only display to solve this problem so that even at night there is no confusion as to the color of the message. When coupled with the fact that it is equally readable in full sunlight, the VIVISUN 20/20 is now recognized as the #1 cockpit display

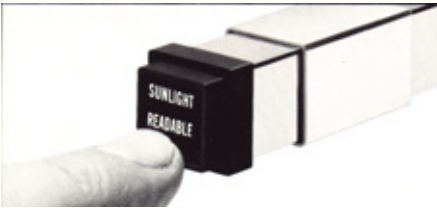
For superior performance in both low level readability and sunlight readability, the VIVISUN 20/20 is the logical solution for the design requirements of the 1980s.

The Lowest Touch Temperature in the Industry.

One of the traditional ways of trying to solve the sunlight readability problem in flight deck switches was to use more power, current, and higher mean spherical candle power lamps to get higher intensity readings on the legends.

Unfortunately, this method not only failed to solve the problem of reading the legends in high light ambiances, but it also created

other problems such as very high surface touch temperatures on the face of the switch, making it extremely uncomfortable, if not actually painful, to actuate.



When Aerospace Optics designed its VIVISUN 20/20 switch, low touch temperature was a primary design goal. With our unique optics, we are able to obtain high contrast ratios under sunlight by using a low power T-1 lamp, thereby avoiding the high power consumption and high levels of radiated heat that are standard for other lighted switches used in the same capacity.

When compared with an ordinary MIL-S-22885 switch under the same test conditions, the VIVISUN 20/20 has a surface touch temperature up to 45% cooler on the front surface of the switch.

		VIVISUN 20/20	Other
5 Volts			
2 lamps	on	6°F	152°F
4 lamps	on	118°F	186°F
28 Volts			
2 lamps	on	110°F	176°F
4 lamps	on	159°F	223°F

The VIVISUN 20/20 is the recognized leader in readability under sunlight conditions; however, as shown above, we do it with much less power, creating a much lower touch temperature.

Night Goggle Readable

Night goggles will be used by Army Advanced Attack Helicopter crews to enhance and multiply the effects of light at night, allowing the crew to see ground targets as bright as day.

While using night goggles, all lighted displays must be trimmed until they are off to the naked eye (ie. 28 volts dimmed to 2 volts). Only night goggles can make

legends and instruments readable at these ultra low levels. But, there are problems.

If an illuminated switch or annunciator has any tendency to "hot-spot" (produce non-uniform illumination), the night goggles dramatically emphasize the problem and in many cases make the legends unreadable. Conventional switches and annunciators, by their very design, "hot-spot."

Aerospace Optics' lines of illuminated pushbutton switches and annunciators are of revolutionary optical design. This unique design assures Night Goggle Readability of unmatched uniformity-no "hot-spotting."

What makes us Sunlight Readable makes us Night Goggle Readable, and this



New Sunlight Readable Blue

The same technology that makes us first in sunlight readable red, yellow, green, and white has now developed a new Sunlight Readable Blue, a blue that, when energized, can be read in a 10,000 foot-candle ambience (direct sunlight), is not discernible when unenergized in a 10,000 foot-candle ambience (direct sunlight), is distinguishable from green at low level night dimmable modes, and with intensities never before attained.

These figures, compiled and certified by an independent testing laboratory will illustrate this:

Average Contrast Ratios (Under 10,000 Foot-Candle Ambience)		
Legend On	Legend On	Legend Off
to	to	to
Legend Off	Background	Background
0.97	0.95	-0.009
Average Intensity at Rated Voltage = 317 foot-lamberts		
CIE Chromaticity Coordinates:		
X = .245 Y = .387		

Let us put our technology to work on our display problems, whether in sunlight or low level ambience.

ELECTRICAL:

Switch Capacity: SPDT, DPDT, and 3PDT Switch arrangement and contact schematic per Figure IV.

Switch Contact Ratings:

Type of Switch	Resistive	Inductive
Silver with gold plate (Types 1, 2, & 3 of Table 3, page 7)	7.0 amps @ 28 VDC Sea level	4.0 amps @ 28 VDC Sea level
	4.0 amps @ 28 VDC @ 50,000 ft.	2.5 amps @ 28 VDC @ 50,000 ft.
Solid Gold (Types 4, 5, & 6 of Table 3, page 7)	1.0 amps @ 28 VDC Sea level	0.5 amps @ 28 VDC Sea level
	1.0 amps @ 28 VDC @ 50,000 ft.	0.5 amps @ 28 VDC @ 50,000 ft.

Contact Resistance:

Switch contacts: .025 ohms maximum. **Lamp contacts:** 1 ohm maximum.

Dielectric Withstanding Voltage: 1000 VRMS minimum, 60Hz.

Switch Contacts: Silver with gold plate or solid gold as specified.

Switch Terminals: Gold plated turret type terminals.

Lamp Terminals: Gold plated solder tabs capable of accepting 1 #20 or 2 #24 gauge wires. Lamp terminal arrangement and schematic per Figure IV

Lamp Type: T-1 flange based lamps as shown in Table 4. Four lamps are provided with each pushbutton switch.

Electrical Life: 25,000 cycles minimum at rated load.

Low Touch Temperature: Our unique optics combined with our low power 5 volt T-1 lamp PIN 17-043 produces a low touch temperature of 86°F with two lamps on, and 118°F with four lamps on.

MECHANICAL:

Dimensions: The pushbutton switch design, construction, and physical dimensions conform to Figures I, II, and III.

Operating Characteristics:

Actuation travel: .150 ± .031.

Actuation force: 2 to 5 pounds.

Pushbutton Cap extraction force: 1 to 4 pounds.

Mechanical Life: 50,000 cycles minimum.

Pushbutton Action: Momentary or alternate

Mounting: Each unit is supplied with mounting sleeve and mounting spacer and units can be mounted in matrix or individual arrangement.

Keying: Pushbutton is designed to prevent incorrect insertion and has a retainer mechanism to hold it captive to the housing.

Relamping: Lamps are replaceable from the front —without tools— by extracting the front pushbutton cap.

Finish: Switch housing is corrosion resistant steel with a lusterless black finish on the front portions.

Low Unit Weight: 1.35 ounces maximum, including mounting sleeve and mounting spacer.

VISUAL:

Sunlight Readable: The background of the legend area is black per FED-STD-595 #37038. The characters are hidden legend type and are not discernable before being illuminated. Legends are sunlight readable at the rated voltage of the illuminating lamp and are readable in a light ambient of 10,000 foot candles (sunlight). When the lamps are not energized the legends are not readable in a 10,000 foot-candle ambient (sunlight).

Contrast: The average contrast ratio of any lighted legend to the background and/or any unlighted legend is .6 minimum in a light ambient of 10,000 foot-candles (sunlight). The contrast ratio is determined as defined in MIL-L-27160 as follows: $C = \frac{B2-B1}{B1}$ where C is the contrast ratio, B2 is the

legend brightness and B1 is the background brightness.

Average Minimum Brightness and Chromaticity Coordinates of each Color:

COLOR	BRIGHTNESS IN FOOT LAMBERTS	CHROMATICITY
		X Y
Red	150	.690 .310
Yellow	300	.585 .410
Green	200	.330 .620
White	200	.430 .400
Blue	150	.260 .390

Lettering Style: Globe condensed caps.

Viewing Angle: 150° Peripherally.

Dimmable: Uniform brightness at reduced voltage levels—nohot spots.

Night Goggle Readable: Uniform illumination under night goggle conditions.

Always Visible Keyboard/Panel Lighting Options: This always visible type of identification lighting is available for all legend positions. In daylight conditions, the legends are white on a black background; and in night conditions, the legends are illuminated either blue-white per MIL-P-83335 or red per MIL-P-7788 Class 1R. See color codes V and N in Table 7 on page 7.

ENVIRONMENTAL:

Temperature: -55°C to 85°C operating; -55°C to 95°C non-operating.

Altitude: Sea level to 50,000 ft.

Shock: In accordance with MIL-S-22885, method 1, 50 G's.

Vibration: In accordance with MIL-S-22885, Test Condition 2.

Moisture Resistance: In accordance with MIL-S-22885.

Fungus: In accordance with MIL-T-5422.

Salt Spray: In accordance with MIL-S-22885.

Sand & Dust: In accordance with MIL-S-22885 non-operating.

Explosion: In accordance with MIL-T-5422, Procedure 1.

FIGURE I- DIMENSIONS

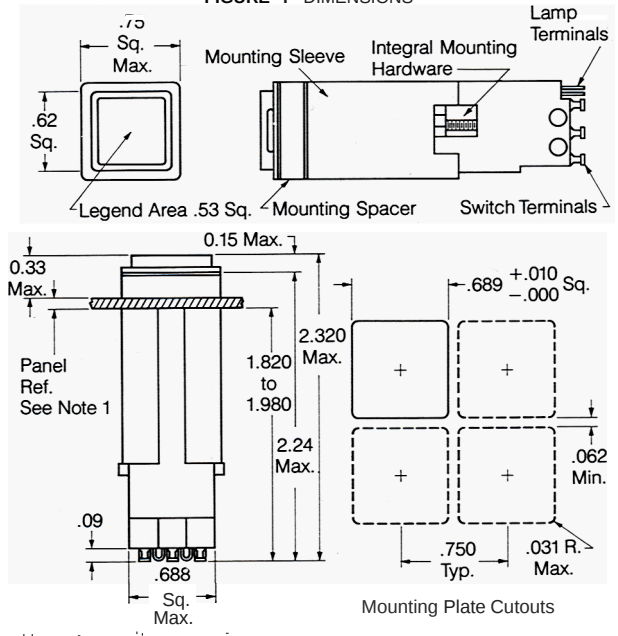
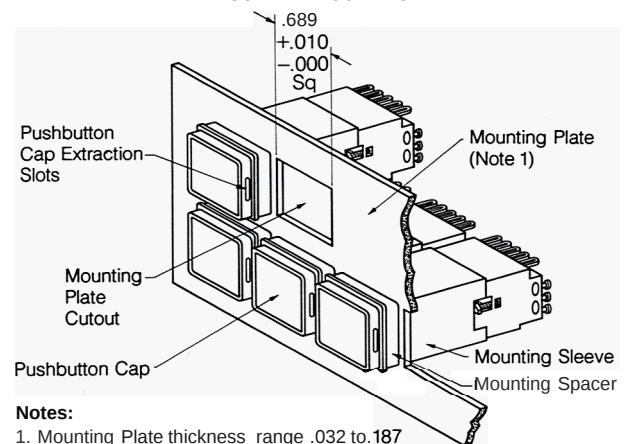


FIGURE II- MOUNTING



Notes:

1. Mounting Plate thickness range .032 to .187
2. Mounting Spacer is used to place switch mounting flange flush with .220 thick Edgelighted Panel.
3. Only a screwdriver is required for installation in mounting plate cutout.
4. Extraction slots in side of legend cap provide for easy front lamp replacement without tools.

FIGURE III- PUSHBUTTON CAP WITH RETAINER

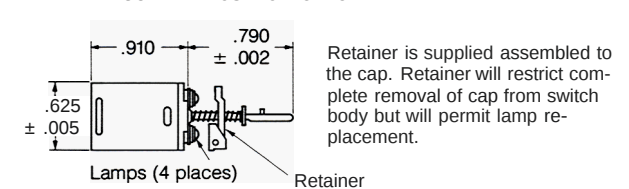
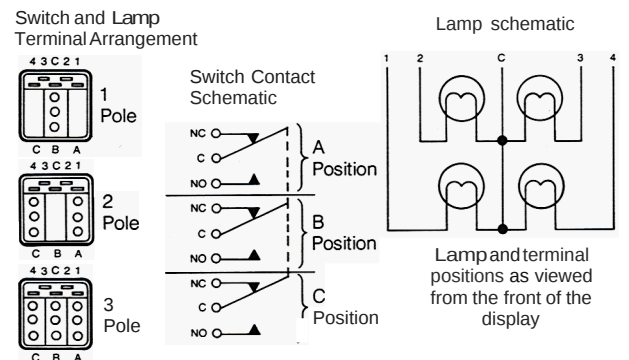
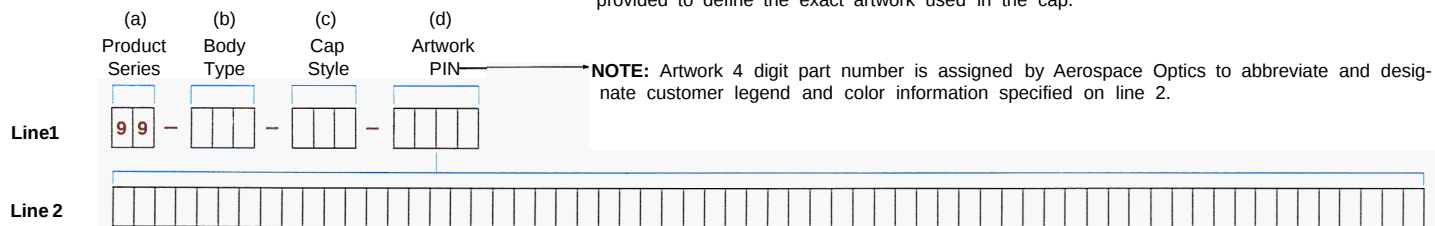


FIGURE IV- SCHEMATIC DIAGRAM



How to Order Vivisun 20/20

Switches and indicators are specified by a basic 12 digit part number which is comprised of (a) 2 digits to define the Aerospace Optics 99 series product line, (b) 3 digits to define switch body type, (c) 3 digits to define the pushbutton cap style, and (d) 4 digit artwork part number. Line 2 is provided to define the exact artwork used in the cap.

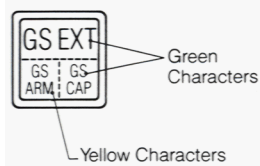


Line 2 provides the detailed artwork description of legend position, color, character height, and corresponding specific legends to be displayed in each legend position. When two or more legend positions are to display information then a semicolon should separate the legend information for each legend position. When two or more lines of characters are to be used in one legend position then the legend lines should be separated by a comma.

TABLE 1 Mounting	2—Figure1 Individual unit mounting with spacer and sleeve													
TABLE 2 Pushbutton Action	1 —MomentaryAction				2—Alternate Action				3—Indicator					
TABLE 3 SwitchPoles	0—Indicator		1—1SPDT		2—2SPDT		3—3SPDT		4- 1SPDT (GOLD)		5- 2SPDT (GOLD)		6- 3SPDT (GOLD)	
TABLE 4 Lamp Type	Type	Lamp Part No			Voltage			Current (amps)			Rated Life Hours			
	1	17-043			5			.060			6,500			
	2	03-014*			5			.115			40,000			
	3	14-112			12			.040			16,000			
	4	14-113			14			.040			16,000			
	5	14-114			18			.026			10,000			
	6	14-104**			28			.024			16,000			
		*MS-24515 **MS-3338												
TABLE 5 Legend Style														
														
TABLE 7 Color	R Red		Y Yellow		G Green		W White		B Blue		V Visible White with Blue White Night Legend Lighting		N Visible White with Red Night Legend Lighting	
TABLE 8 Character Capacity per Legend Position	Character Size	Character Height	Lines /Characters			Legend Position Per Table 6								
						1	2-3		4-5-6-7		8-9			
	1	.125	Lines Per Position			3	1		1		3			
			Characters Per Line			6	6		3		3			
	2	.109	Lines Per Position			3	1		1		3			
			Characters Per Line			7	7		3		3			
	3	.072	Lines Per Position			5	2		2		5			
			Characters Per Line			8	8		4		4			
4	.156	Lines Per Position			2	1		1		2				
		Characters Per Line			4	4		2		2				

Example

How to order
a typical
switch having
legend Style E



Vivisun 20/20 99 Series

Mounting Configuration Indicate number per table 1

Pushbutton Action Indicate number per table 2

Switch Poles Required Indicate number per table 3

Lamp Type Indicate number per table 4

Legend Style Indicate letter per table 5

Pushbutton cap captivation 1-with retaining mechanism

Artwork Part Number Assigned by Aerospace Optics at time of customer request

Line 1

99 - 212 - 1E1 - 8361

Line 2

(2 G 1 G S E X T ; 6 Y 3 G S , A R M ; 7 G 3 G S , C A P)

Parenthesis
to start artwork description

Legend Position
Indicate number per table 6

Color Indicate letter per table 7

Character Size
Indicate number per table 8

Legend On First Line GSEXT

Insert Semicolon between legend positions

Legend Position Indicate number per table 6

Color Indicate letter per table 7

Character Size Indicate number per table 8

Legend On First Line GS

Insert Comma between legends on 1st and 2nd lines

Legend On Second Line ARM

Insert Semicolon between legend positions

Legend Position Indicate number per table 6

Color Indicate letter per table 7

Character Size Indicate number per table 8

Legend On First Line GS

Insert Comma between legends on 1st and 2nd lines

Legend On Second Line CAP

Insert Parenthesis to denote end of artwork description

How to order Spare Components

1. To order typical spare Vivisun 20/20 pushbutton cap only:

(from example above)

99 - XXX - 1E1 - 8361

Insert X's in body type spaces to denote pushbutton cap only

2. To order typical spare Vivisun 20/20 body only:

99 - 212 (from example above)

3. To order typical spare lamps only:
17-043 (lamptype 1 from example above and Table 4)

Vivisun 20/20™



Data and Ordering Information



Only VIVISUN 20/20 gives you all of these important features:

Sunlight Readable

Designed and fully qualified to Mil-S-22885/90.

No Ghosting

Maintains total dead face in direct sunlight when not energized.

Dimmable

Uniform brightness at reduced voltage levels. No hot spots.

Night Goggle Readable

Uniform illumination under night goggle conditions.

Low Touch Temperature

Lowest in the industry.

150° Viewing Angle Peripherally

Widest in the industry.

Versatile

Pushbutton switch and/or indicator.

Easy Maintenance

Lamps replace from the front without tools.

5 Sunlight Readable Colors

Red, yellow, green, white, blue.

Low Power

5 to 28 volt T-1 lamps.

Low Weight

1.35 ounces.

Small Size

.688" x .688" x 2.24".

Quick and Easy Installation

Individual unit or matrix arrangement.

Up to 4 Separate Messages per Single Unit**Momentary or Alternate Pushbutton Action****1, 2 or 3 Pole Capacity****Competitively Priced****Available Now**

Researchers,
Designers
and
Manufacturers
of Sunlight
Readable
Switches



AEROSPACE OPTICS INC.

3201 Sandy Lane, Fort Worth, Texas 76112
(817) 451-1141

Vivisun 20/20™ Switches Now ANVIS Compatible

VIVISUN 20/20 NVG Compatible Switches: By utilizing a unique optics system, the VIVISUN 20/20 NVG switches combine both low level lighting compatibility for use with the ANVIS (Aviator's Night Vision Imaging System) and the PVS-5A (Gen II) night vision goggles along with sunlight readability. This wide range of visual applications now offers crew station members optimum night mission execution and safety combined with readability in direct sunlight for daytime missions.

Importance of Compatibility: For NVG compatibility a display's emitted energy must be minimized where the goggles are highly sensitive and maximized at the peak sensitivity of the eye. Graph 1 shows that the ANVIS sensitivity is much higher than the PVS-5A sensitivity where the night sky irradiance is greatest. Graph 2 shows the response of the ANVIS goggles compared to the response of the unaided eye. This graph shows that the ANVIS goggles simplify compatibility because they have a sharp cutoff of sensitivity near 600 nm. This excludes most of the visible spectrum so that displays with emitted energy below 600 nm will not interfere with the goggles. Crew members can look beneath the ANVIS goggles and see the displays with the unaided eye. Graph 3 shows the response of the PVS-5A goggles which are sensitive to energy in the visible spectrum. Previously compatibility required reducing the voltage of the display to such a low level that they were not discernible to the unaided eye. The VIVISUN 20/20 NVG displays provide lighting at a level high enough to be read with the unaided eye and still comfortably readable through the PVS-5A goggles.

Red Fraction: (Graph 2) The VIVISUN 20/20 NVG displays are designed to minimize red and infrared emissions above 600 nm thus allowing the ANVIS goggles to detect only a small fraction of the total energy. This fraction of energy detected is called the red fraction and is the amount of energy above 600 nm divided by the total energy from 400 nm to 900 nm. The red fraction of energy emitted from the VIVISUN 20/20 NVG displays is less than 1%.

Luminous Efficiency: (Graph 3) The ratio of perceived luminosity to the energy required to produce that luminosity is called the luminous efficiency and has a maximum value of 673 lumens/watt at the peak sensitivity of the eye (550 nm). The VIVISUN 20/20 NVG displays achieve a luminous efficiency greater than 400 lumens/watt. This is a desirable luminous efficiency which allows the display to be seen with the unaided eye without driving the PVS-5A into a reduced gain by the Automatic Light Control (ALC).

Non Interference with Goggles: The VIVISUN 20/20 NVG displays eliminate the veiling glare and halo effect which current displays emit. Elimination of these effects enables the cockpit windscreen and canopy to be free of any reflected light or glare interference which would limit the sensitivity (ALC) of the ANVIS or PVS-5A goggles. Also elimination of these effects removes the potential of emitting a detectable cockpit target signature.

Sunlight Readable: VIVISUN 20/20 NVG displays are also capable of being read in direct sunlight per Mil-S-22885/90. Legends are readable in 10,000 ft. candles and remain dead-face when not energized.

Voltage and Intensity Levels for 28 V System: The typical voltage setting for ANVIS compatibility is 6.5 v which allows for .2 ft. lamberts. For the PVS-5A the typical voltage setting should be 5 v which allows for .04 ft. lamberts.

Color: The VIVISUN 20/20 NVG display illuminates in green only. The dominant wavelength is at 550 nm.

Lettering Style: Futura medium condensed.



ANVIS (Aviator's Night Vision Imaging System)



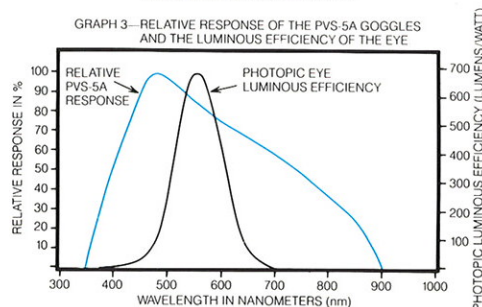
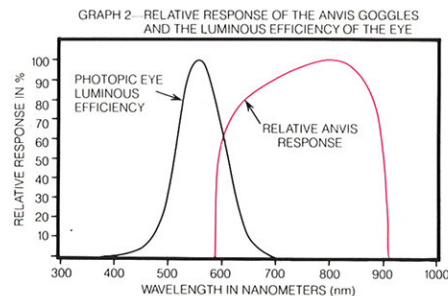
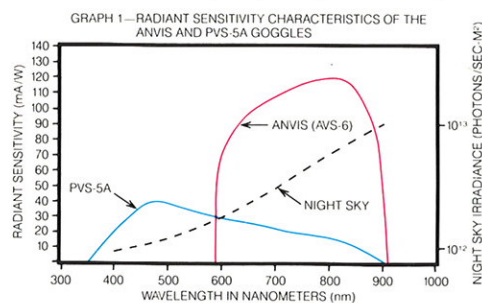
PVS-5A (Gen II)



Mil-S-22885/90

Performance: The VIVISUN 20/20 NVG displays have been evaluated by the U.S. Army's Night Vision and Electro Optic Laboratory and have proven to be compatible with ANVIS and PVS-5A night vision goggles.

Testing: Testing a display for NVG compatibility cannot be done accurately using direct photometric measurements because of the abrupt decrease in photometer sensitivity in the red and infrared regions. Aerospace Optics engineering has established a reliable method for assuring that each display meets the objectives of NVG compatibility. A spectroradiometer is used to measure the absolute spectral radiance of the display. The RED FRACTION ratio is then calculated by the mathematical convolution of the absolute spectral radiance and the relative ANVIS response. Similarly the LUMINOUS EFFICIENCY is calculated by the convolution of the absolute spectral radiance and the photopic response of the eye.



Product Series	Body Type	Cap Style	Artwork P/N
99			

How to order Vivisun 20/20 NVG compatible option

To designate a VIVISUN 20/20 NVG switch simply insert the proper letter from Table 1 that describes the NVG legend style. For ordering spare caps only, select proper letter from Table 1 and insert X's in the body type. For additional information on how to order VIVISUN 20/20 refer to page 7 of data sheet 99-1-78-2.

TABLE 1—NVG Legend Style

K	L	M	N
P	Q	R	S

Refer to Standard Data Sheet 99-1-78-2 pg. 6 for all other electrical, mechanical, visual and environmental characteristics of Vivisun 20/20.

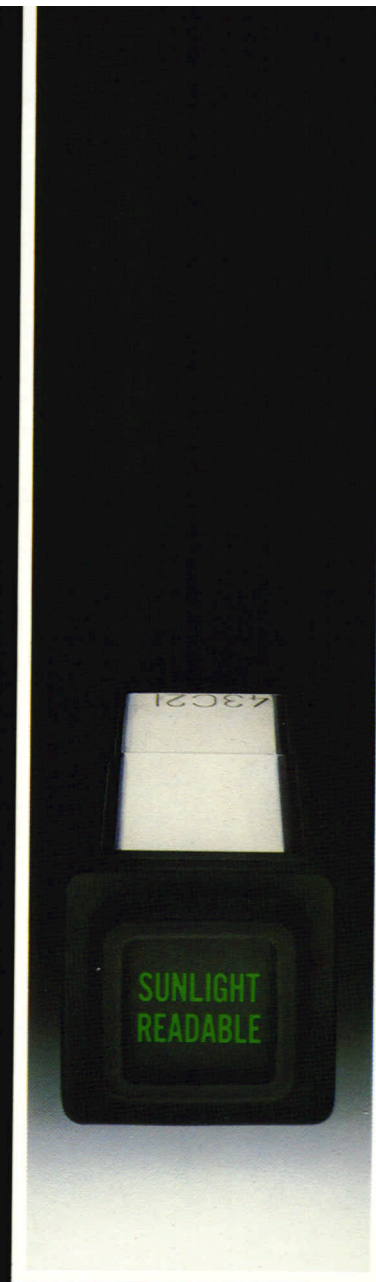
Supplement No. 2
DATA SHEET NO. 99-1-78-2

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Vivisun 20/20™
Options

Vivisun 20/20 Options

In addition to the standard VIVISUN 20/20 Mil-S-22885/90 qualified illuminated pushbutton switch, the following options have been developed to give the VIVISUN 20/20 more flexibility in special design applications:

- Split Ground—Horizontal
- Vertical
- Printed Circuit Board Pins Termination
- EMI—Shielding effectiveness in excess of 60dB
- Dustproof/Dripproof—Split ground and EMI units available in a dustproof/dripproof enclosure design

SPLIT GROUND OPTION

The standard VIVISUN 20/20 provides for a lamp circuit which has one input to each of the four lamps and a single ground common to all four lamps. The horizontal split ground option provides for a lamp circuit which has one input to each of the four lamps and two separate grounds, one connecting the upper two lamps and one connecting the lower two lamps. The vertical split ground option provides for a lamp circuit which has one input to each of the four lamps and two separate grounds, one connecting the two left positioned lamps and one connecting the two right positioned lamps. (See Figure VII)

- a) The horizontal split ground option is commonly used in dual channel applications wherein the upper legend lamp circuit on a horizontal B style split screen display must be totally separated from the lower legend lamp circuit insuring separate integrity of the two legend positions. (See Figure VII and Table 5)
- b) The vertical split ground option can be used to achieve separate integrity on a vertical F style split screen display. (See Figure VII and Table 5)
- c) The vertical split ground option can also be used to provide systems reliability in a horizontal B style split screen display by allowing the two left positioned lamps to be operated from one power supply while the two right positioned lamps are operated from another separate power supply. This insures that in the event of failure of one power supply, both the upper and lower legends will still have one lamp operating thus increasing the system's reliability.
- d) The horizontal split ground option can be used in an analogous manner to item c) above to provide systems reliability in a vertical F style split screen display

PRINTED CIRCUIT BOARD PINS TERMINATION OPTION

The split ground units are available with the lamp contactors terminating in either the standard solder tabs or the printed circuit board pins option. (See Figures VII, VIII, and IX)

- a) The standard solder tab terminations are capable of accepting 1 #20 or 2 #24 gauge wires. The switch terminals are solderable turret type terminals.
- b) The printed circuit board termination option provides .056" diameter pins located on a .105" minimum center to center spacing allowing them to be used as solder pin terminations for printed circuit board and flex circuit board applications. The switch terminations are also printed circuit board pins. (See Figure VII)
- c) The printed circuit board pins can also be used to provide a quick connect-disconnect termination when mated with AMP .058 diameter pin receptacles. The AMP p/n 60804-4 receptacle is used for wire size #26 to #22 gauge and AMP p/n 60598-8 receptacle is used for wire size #24 to #20 gauge. These receptacles are crimped onto the wire so as to provide a solderless termination which can be quickly connected and disconnected.

DUSTPROOF/DRIPPROOF OPTION

The horizontal split ground switch, vertical split ground switch and EMI option are available in the dustproof/dripproof enclosure design. These switches are supplied with a mounting sleeve, dustproof/dripproof mounting spacer, dustproof/dripproof mounting flange, and pushbutton cap having a permanently attached silicon rubber dustproof/dripproof seal. All momentary and alternative action dustproof/dripproof sealed switches operate from -48°C to +85°C max. Dustproof/dripproof indicators can be used down to -55°C.

All VIVISUN 20/20 dustproof/dripproof switches and indicators meet the enclosure design type (2) requirements of Mil-S-22885 as specified in para. 3.6.17.2. When tested per para. 4.8.17.2 the dripproof seal does not allow leakage of water through the seal as determined by visual examination and the dielectric test of para. 4.8.16.1.

The dustproof/dripproof switches are dustproof as defined in Mil-Std-810E and are tested in accordance with Method 510 Dust Test of Mil-Std-810. When mounted in equipment, the dustproof enclosure allows the switches to operate satisfactorily in the presence of a dry dust/fine sand atmosphere. (See Figure IX and Data Sheet 99-1-78-2 Supplement No. 1)

EMI OPTION

The standard VIVISUN 20/20 switches and the split ground option switches are available with an EMI option wherein the design provides for an electromagnetic interference shielding effectiveness in excess of 60 decibels of attenuation in the frequency range of 14 KHz to 1000 MHz. Also the radiated field strength of a signal injected onto the lamp leads or switch leads of a switch mounted in an EMI tight enclosure is 60 decibels below the injected signal strength. For example, a 100,000 microvolt signal injected directly onto the lamp leads or switch leads would generate a radiated field strength not in excess of 100 microvolts over the frequency range of 14 KHz to 1000 MHz. This design also meets the following EMI requirements:

- a) The switches meet the EMI minimum attenuation requirements of Mil-S-22885 when tested in accordance with the general procedures specified in Mil-Std-285. This test consists of electric field and plane wave measurements at the specified frequencies from 15 KHz to 10 GHz. (See Figure X)
- b) The switches comply with the EMI internal signal shielding requirements of Mil-Std-461, RE02 limits for narrowband E-field emissions in the frequency range of 14 KHz to 1000 MHz resulting from a 100 dB (0.1 volt) RF signal applied directly onto the lamp leads or switch leads and the resulting radiated field strength is below the Mil-Std-461, RE02 limit. (See Figure XI)
- c) The switches comply with the EMI broadband E-field emissions requirement of Mil-Std-461, RE02 limits for radiated switching transients in the frequency range of 14 KHz to 1000 MHz resulting from the cycling of electrical switching circuitry. In this test, all four lamps are connected to the switch circuit with full rated voltage then turned on and turned off by actuating the switch. The resulting radiated switching transient measured during the turn on and turn off cycles is below the Mil-Std-461, RE02 limit. (See Figure XII)
- d) The switches radiate no emissions in the frequency range of 1 MHz to 25 MHz when a 10 MHz, 5 volt clocking pulse with a 5 to 10 monosecond rise time is injected directly onto the lamp leads. This simulates the typical clocking pulse in computer equipment.

FIGURE X

MIL-S-22885 MINIMUM ELECTROMAGNETIC INTERFERENCE ATTENUATION REQUIREMENTS

When the switches are tested in accordance with the general procedures of Mil-Std-285, the EMI attenuation is not less than the limits shown in the graph adjacent. The test consists of electric field and plane wave measurements performed at the following frequencies.

Electric Field	Minimum Attenuation	Plane Wave	Minimum Attenuation
15 KHz	60 dB	100 MHz	47dB
150 KHz	60 dB	400 MHz	39dB
500 KHz	60 dB	1 GHz	33dB
1 MHz	60 dB	2.5 GHz	28dB
10 MHz	60 dB	10 GHz	20dB

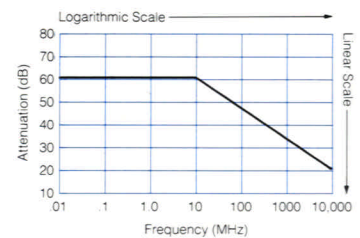


FIGURE XI

MIL-STD-461 MAXIMUM ELECTROMAGNETIC INTERFERENCE LIMITS FOR NARROWBAND E-FIELD EMISSIONS

With a switch mounted in one wall of an EMI tight enclosure, a 100 dB signal is injected directly onto the lamp leads or switch leads. The radiated narrowband E-field emissions for frequencies less than 1000 MHz are not in excess of the maximum values shown in the graph below when measured at a distance of one meter.

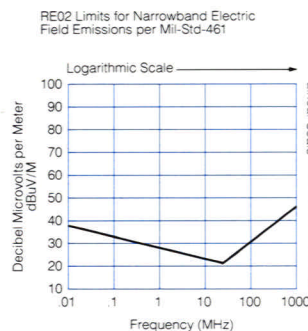


FIGURE XII

MIL-STD-461 MAXIMUM ELECTROMAGNETIC INTERFERENCE LIMITS FOR BROADBAND E-FIELD EMISSIONS

With a switch mounted in one wall of an EMI tight enclosure, all four lamps are connected to the switching circuit. The lamps are energized with full rated voltage and turned on and off by actuating the switch. The resulting radiated switching transient emissions are not in excess of the maximum values shown in the graph below when measured at a distance of one meter.

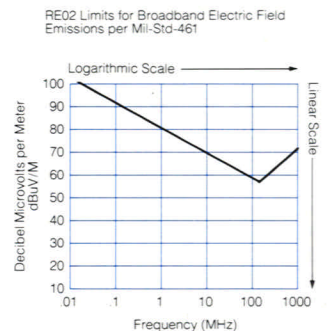
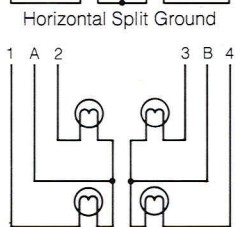
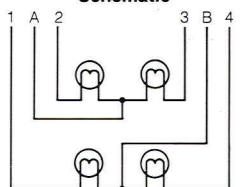


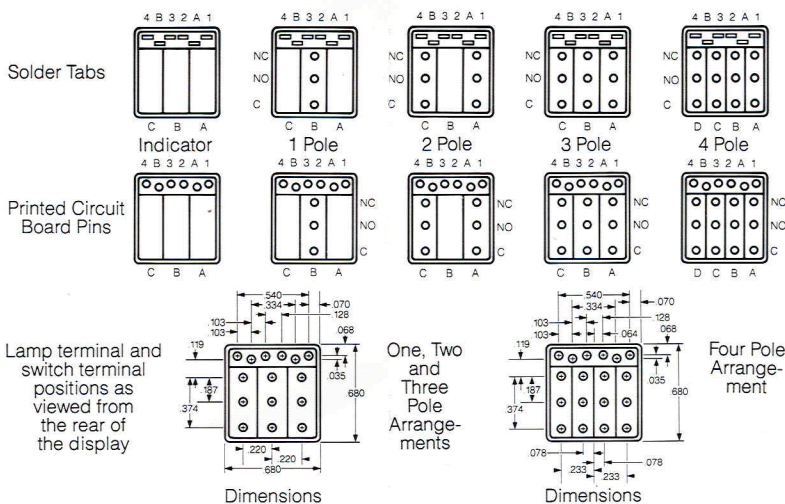
FIGURE VII—SPLIT GROUND SCHEMATIC DIAGRAM

Split Ground Lamp Circuit Schematic



Lamp and terminal positions as viewed from the front of the display.

Switch Pole and Lamp Terminal Arrangement



Switch Contact Schematic

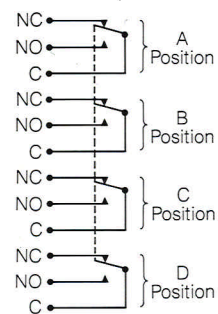
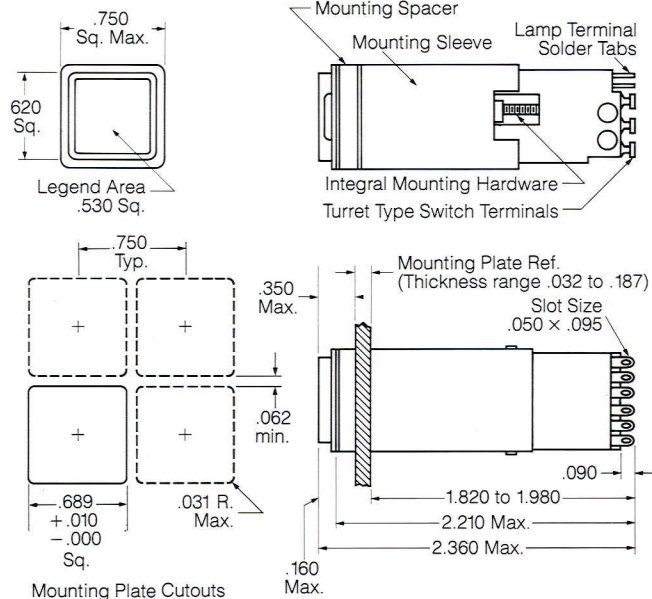
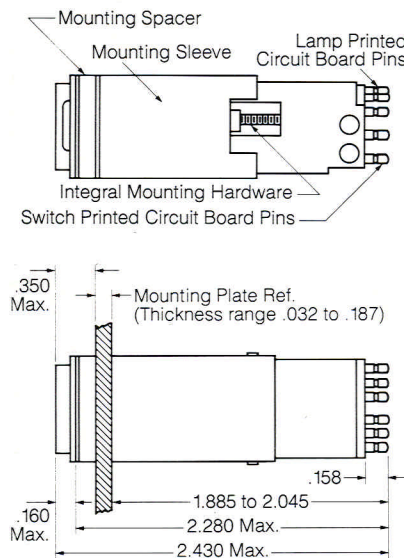


FIGURE VIII—UNSEALED SPLIT GROUND MOUNTING DIMENSIONS

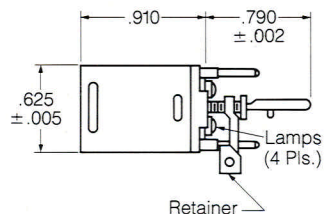
With Solder Tabs



With Printed Circuit Board Pins



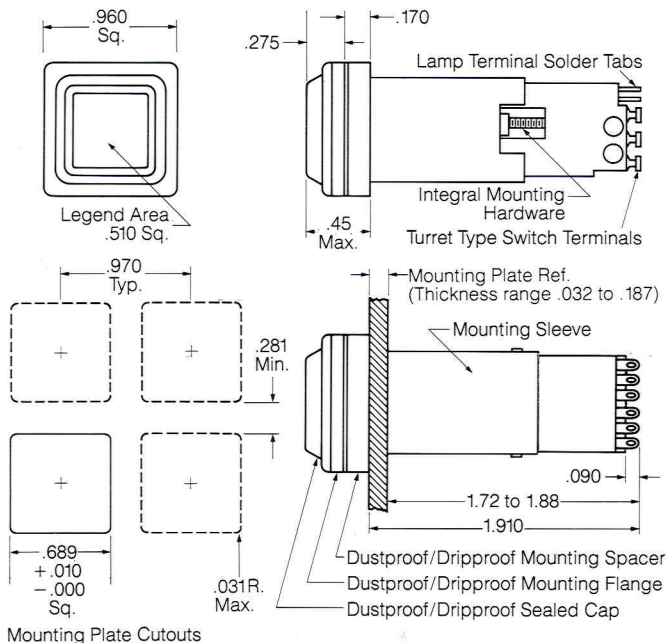
Pushbutton Cap



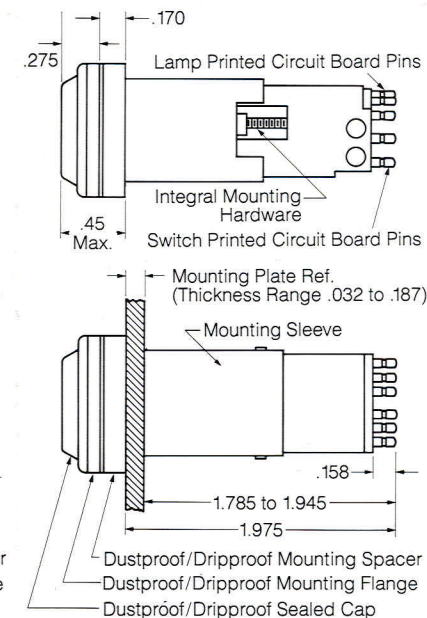
Retainer is supplied assembled to the cap. Retainer will restrict complete removal of cap from switch body but will permit lamp replacement.

FIGURE IX—DUSTPROOF/DRIPPROOF SEALED SPLIT GROUND MOUNTING DIMENSIONS

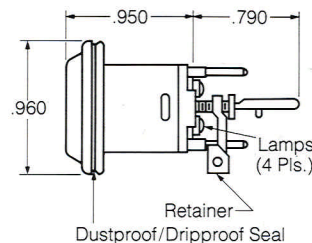
With Solder Tabs



With Printed Circuit Board Pins



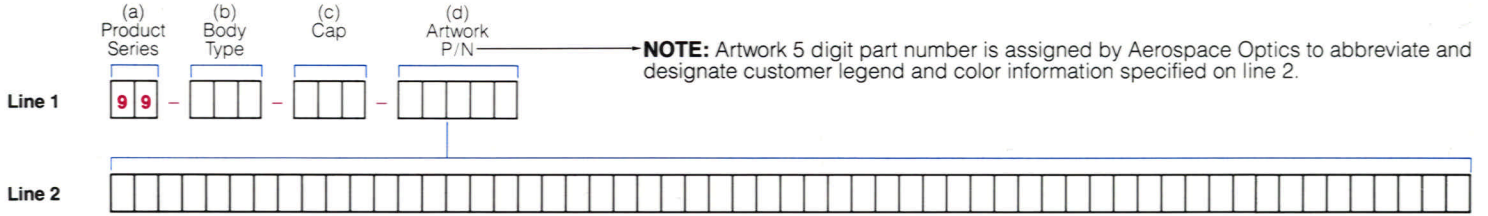
Pushbutton Cap



Dustproof/Dripproof seal and pushbutton cap are integral one piece assembly.

How to order Vivisun 20/20 Options

Switches and indicators are specified by a basic 13 digit part number which is comprised of (a) 2 digits to define the Aerospace Optics 99 series product line, (b) 3 digits to define switch body type, (c) 3 digits to define the pushbutton cap, and (d) 5 digit artwork part number. Line 2 is provided to define the exact artwork used in the cap.



Line 2 provides the detailed artwork description of legend position, color, character height, and corresponding specific legends to be displayed in each legend position. When two or more legend positions (see Table 6) are to display information then a semicolon should separate the legend information for each legend position. When two or more lines of characters (see Table 8) are to be used in one legend position then the legend lines should be separated by a comma.

To specify a VIVISUN 20/20 pushbutton switch or indicator with options, determine the basic part number as follows:

- 1) Select the desired lamp circuit, termination and enclosure design from the switch housing configurations listed in Table 1. Choose the appropriate type designation number from Table 1 and insert this number into the third position of the basic 13 digit part number.
- 2) Select the desired pushbutton action either with or without the EMI option as listed in Table 2 and insert the appropriate designation number into the fourth position of the basic 13 digit part number.
- 3) Select the desired pushbutton cap style from Table 9 and insert this number into the fifth position of the basic 13 digit part number.
- 4) Select the desired pushbutton cap style from Table 9 making sure it is compatible with the switch housing configuration selected in step 1. Choose the appropriate cap style designation symbol from Table 9 and insert this number into the eighth position of the basic 13 digit part number.
- 5) Complete the part number by using Tables 4, 5, 6, 7, 8, and the example on page 4.

TABLE 1 Switch Housing Configuration (all with individual unit mounting)	Lamp Circuit	Termination	Unsealed	Dustproof/Dripproof				
	Common Ground	Solder Tabs	2	4				
	Split Ground Horizontal	Solder Tabs	5	7				
		Printed Circuit Board Pins	6	8				
	Split Ground Vertical	Solder Tabs	5	7				
Printed Circuit Board Pins		6	8					
TABLE 2 Pushbutton Action and EMI	1—Momentary Action		2—Alternate Action	3—Indicator				
	4—Momentary Action with EMI		5—Alternate Action with EMI	6—Indicator with EMI				
TABLE 3 Switch Poles	0—Indicator	1—1 SPDT	2—2 SPDT	3—3 SPDT	P—4 SPDT			
		4—1 SPDT (Gold)	5—2 SPDT (Gold)	6—3 SPDT (Gold)	R—4 SPDT (Gold)			
TABLE 4 Lamp Type	Type	Lamp Part No.	Voltage	Current (amps)	Rated Life Hours			
	1	17-043	5	.060	6,500			
	2	03-014*	5	.115	40,000			
	3	14-112	12	.040	16,000			
	4	14-113	14	.040	16,000			
	5	14-114	18	.026	10,000			
	6	14-104**	28	.024	16,000			
		*MS-24515 **MS-3338						
TABLE 5 Legend Style	B	C	D	E	F	G	J	H
TABLE 6 Legend Position								
	2 3	4 5 3	4 5 6 7	2 6 7	8 9	4 9 6	8 5 7	1
TABLE 7 Color	R Red	Y Yellow	G Green	W White	B Blue	V Visible White with Blue White Night Legend Lighting	N Visible White with Red Night Legend Lighting	
TABLE 8 Character Capacity per Legend Position	Character Size	Character Height	Lines/Characters	Legend Position Per Table 6				
				1	2-3	4-5-6-7	8-9	
	1	.125	Lines Per Position	3	1	1	3	
			Characters Per Line	6	6	3	3	
	2	.109	Lines Per Position	3	1	1	3	
			Characters Per Line	7	7	3	3	
	3	.072	Lines Per Position	5	2	2	5	
			Characters Per Line	8	8	4	4	
	4	.156	Lines Per Position	2	1	1	2	
			Characters Per Line	4	4	2	2	

TABLE 9 Pushbutton Cap Style (all styles include retainer)	Lamp Circuit	Unsealed	Dustproof/Dripproof	With EMI Option	
				Unsealed	Dustproof/Dripproof
	Common Ground	1	2	L	M
	Split Ground Horizontal	3	4	N	R
	Split Ground Vertical	5	6	S	T

Note: Pushbutton cap styles are to be selected and used with corresponding compatible bodies. For example, a split ground horizontal EMI cap is used with a split ground horizontal EMI body.

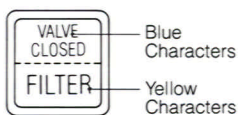
Refer to Standard Data Sheet 99-1-78-2 for all other electrical, mechanical, visual and environmental characteristics of Vivisun 20/20.

Example

How to order a typical VIVISUN 20/20 switch having 2 poles, alternate action, 28 volt lamps, legend style B, and the following options:

- Split ground horizontal lamp circuit
- Printed circuit board pins termination

- Dustproof/Dripproof enclosure
- EMI



Vivisun 20/20 99 Series

Switch Housing Configuration Indicate number per table 1

Pushbutton Action and EMI Option Indicate number per table 2

Switch Poles Required Indicate number per table 3

Lamp Type Indicate number per table 4

Legend Style Indicate number per table 5

Pushbutton Cap Style Indicate number or letter per table 9

Artwork Part Number Assigned by Aerospace Optics at time of customer request

Line 1

99 - 852 - 6BR - 10586

Line 2

(2 B 3 VALVE, CLOSED; 3 Y 1 FILTER)

Parentheses to start artwork description

Legend Position Indicate number per table 6

Color Indicate letter per table 7

Character Size Indicate number per table 8

Legend On First Line VALVE

Insert Comma between legends on 1st and 2nd lines

Legend On Second Line CLOSED

Insert Semicolon between legend positions

Legend Position Indicate number per table 6

Color Indicate letter per table 7

Character Size Indicate number per table 8

Legend On First Line FILTER

Insert Parentheses to denote end of artwork description

How to order Spare Components

1. To order typical spare Vivisun 20/20 pushbutton cap only:

(from example above)

99 - XXX - 6BR - 10586

Insert X's in body type spaces to denote pushbutton cap only

2. To order typical spare Vivisun 20/20 body only:

99 - 852 (from example above)

3. To order typical spare lamps only:
14-104 (lamp type 6 from example above and Table 4)

NOTE: For repeat orders, only the 13 digit part number on line 1 is required.



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